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SCIENCE AND TECHNOLOGY

No. 51

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WEST EUROPE REPORT

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CONTENTS

CHEMICALS

OFFSHORE TECHNOLOGY TO USE SPACE-AGE COMPOSITE MATERIALS

Paris INDUSTRIES & TECHNIQUES in French 20 Jan 81 pp 45-47

[Article by J.H.]

[Text] The composite materials developed for use in space are coming back to us for applications on land and in the oceans. Composite tubing of glass fiber or carbon fiber withstands the high pressures of offshore equipment without damage. And carbon-carbon materials are giving rise to brake components that are highly resistant to wear and heat.

Lightness, corrosion resistance, and high mechanical performance make it desirable to use composite materials beneath the sea and on the surface. Especially since they help reduce operating costs. The French Petroleum Institute has been collaborating for nearly 2 years with the Ballistic and Space Systems Division of AEROSPATIALE [National Industrial Aerospace Company] to develop the offshore use of composite materials.

In the course of its space research, that division has gained considerable competence in the production of high-performance composite materials. After more than a year of collaboration, the results are particularly encouraging. The first deepsea tests on tubing for vertical connections demonstrated both the quality of its performance and the reproducibility of the manufacturing process. The tubing and its connecting fittings have been thoroughly tried and tested.

Studies carried out this year in cooperation with equipment users and manufacturers have made clear the new applications for these composite materials. Since the material exhibits remarkable strength in the face of high pressures, it can be used with advantage to replace certain metal cylinders that are used in an ocean environment. With a working pressure of 300 bars, those containers will be of interest to firefighters (rescue missions) or divers. The number of permissible cycles at working pressure may total several thousand. At equal volumes, a significant decrease in the weight of the package is also achieved. The experts at Air Liquide in particular are interested in the new material.

The carbon-carbon composite materials designed by the space program for reentry bodies and thrust nozzles also have interesting applications on the ground, notably because of their "heat sink" characteristics and their mechanical aspects. These materials are of interest to aircraft manufacturers or the manufacturers of heavy vehicles (tanks, trucks, and so on) from the standpoint of their use in brake manufacture:

their friction coefficient remains stable throughout the braking period regardless of the final temperature, and their resistance to thermal shock in case of sudden braking action is excellent. There is very little wear from each instance of braking: in aeronautics, it is on the order of .001 millimeter per landing. On the Concorde, the preexisting carbon brakes were very costly. The price of AEROSPATIALE's "aerolor" is said to be much more modest.

Reliable and Three Times Lighter

Glass fiber composite tubing for offshore vertical connections:

Weight per meter: 5 kilograms (three times lighter than a 100HB steel pipe with the same working pressure).

Inside diameter: 103 mm.

Outside diameter: 118 mm.

Working pressure: 350 bars; safety factor greater than or equal to 3.

Carbon fiber composite tubing for vertical connections:

Weight per meter: 3.8 kilograms (four times lighter than a 100HB steel pipe with the same working pressure).

Inside diameter: 103 mm.

Outside diameter: 118 mm.

Working pressure: 350 bars; safety factor greater than or equal to 3.

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RESEARCHERS MAKE PROGRESS IN HYDROGEN PRODUCTION, STORAGE

Paris LE MATIN in French 2 Feb 81 p 16

[Article by Robert Clarke: "Hydrogen, Tomorrow's Petroleum"]

[Excerpt] A team headed by Paul Perroux, at the Center for Nuclear Studies in Grenoble, has developed an electrolysis machine which may be marketed in the near future. It produces hydrogen at a lower cost through the use of high temperature and pressure. In an adjacent laboratory Viguie is trying to develop an electrolytic cell which could prove to be even more effective, since it requires a heat of 850 degrees.

On a parallel basis, work is underway to develop more convenient hydrogen storage systems compared with steel cylinders for the compression and transportation of liquified hydrogen. The main features of the studies in Grenoble and Bordeaux, conducted under Prof Paul Hagenmuller, are concentrated on metallic components or "hydrides" which act like hydrogen sponges. Exposed to gas under pressure these components break down into a powder and absorb the hydrogen molecules which thus become stored safely and economically. Heat releases the oxygen from the hydrides.

One could, therefore, already conceive of running a bus or a truck with such hydrides. The approximately 40 kg of hydrogen which would be required for a 200 km run daily could be contained in less than 2 tons of hydrides. This is a substantial weight which, however, is less than than that of the batteries which would be needed to operate an electrically powered vehicle. Assuming, as the Grenoble and Bordeaux researchers believe, that further progress will be made soon, we may hope that in the race for new fuels, in a few years hydrogen could assume an honorable place.

However, if we are to reach a real "hydrogen civilization," which some people promote, even more effective and less expensive procedures for the production of hydrogen should be developed. Two of them, still in the laboratory stage, are very promising.

The first is one developed by biologists of the group headed by Paulette Vignais of the Center for Nuclear Studies in Grenoble. This group is working on some microorganisms which owe their survival to two enzymes: hydrogenase and nitrogenase. If these microorganisms are placed in a specific living environment and if they are prevented, for example, from growing and producing a biomass, the function of the enzymes is reversed and they begin to produce hydrogen. This turns the bacteria into gas production "biological plants." In the future, such a procedure could be used by small hydrogen production decentralized units.

The other, "photolytic," procedure is more ambitious yet equally promising. It is being experimented with in Strasbourg by a group headed by Professor Lehn of the National Scientific Research Center, which is one of the most advanced in the world in this area. This group is developing a procedure for the photodecomposition of water in hydrogen and oxygen through solar radiation. A kind of "photochemical" battery" has been developed under laboratory conditions, which produces hydrogen within a continuous circuit. This system, still in its embryonic stage, may develop into one of the most effective means for the storing of solar energy, something which has not been achieved yet. Its conversion into hydrides would provide a simple and classical solution to the storage problem which would make a number of applications possible

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BRIEFS

DUTCH-BELGIAN FUEL CELL--The Hague--Prototypes of a bus powered by a fuel cell that transforms hydrogen directly into electricity will be placed in service within 2 or 3 years by the Belgian firm ELENCO [expansion unknown] and the Dutch nationalized chemical firm DSM [expansion unknown], which worked together to perfect the system. In an interview with the Dutch press agency, ELENCO's manager Van Den Broeck said that the performance of vehicles using that energy source may be comparable to that provided by internal combustion engines (gasoline and diesel fuel) but without producing either noise or air pollution. The first buses equipped with this fuel cell reportedly have a range of from 250 to 300 kilometers, which is adequate in normal urban service. They are refilled with hydrogen every evening. The fuel cells are said to have a service life of 5,000 hours, but according to Van Den Broeck, that may be doubled in the future. This means that a private automobile could cover 500,000 kilometers using the same fuel cell. [Text] [Paris AFP SCIENCES in French 22 Jan 81 p 50] 11798

CSO: 3102

CODIS ACTS TO PROMOTE SET-UP OF FLEXIBLE WORKSHOPS

Paris L'USINE NOUVELLE in French 5 Feb 81 pp 63-64

[Article by Georges Le Gall]

[Text] The first French flexible workshop will start operation during 1981 at the Renault industrial vehicles plant in Boutheon, near Saint-Etienne. The plant includes in particular equipment provided by Renault Machines-Outils, CIT-Alcatel, and Num and will machine parts for truck gear-boxes. The decision to build this plant dates from before the creation of Codis whose robotics working group (flexible workshops, robots, assembling machines, automatic systems components) only started consultations in February 1980 with a double objective: to improve businessmen's consciousness of the problem, and to allow plant engineers to obtain their first experience in the field.

The first two projects were selected last December. The leading companies in one of the projects are the automatic industrial company, recently created by a subsidiary of the general company specializing in automation, Sg2 (which holds 40% of the capital), the Peugeot group (30%), and Rhone-Poulenc (10%).

The industrial automaton flexible workshop will be set up in the new Citroen plant at Meudon for machining prototype engine blocks and oil pans. It is in fact the Peugeot group which, about a year ago, took the initiative of looking for partners for a joint study of the most recent automatic processes. The second project involves the CGE [General Electric Company] group whose CGA subsidiary (Compagnie Generale d'Automatismes) will set up a flexible workshop in the Orleans Alsthom plant (alternators and motors).

But other projects have been submitted to Codis, and two or three will probably be selected in the near future, either those submitted by Ernault-Somua, Sagem, Telemecanique, and Thomson. Using its own equipment (machining centers), those of companies of the Empain-Schneider group working on automatic processes, and those of outside companies (Robots Renault for instance), Ernault-Somua is considering setting up a flexible workshop for the production of lathes in its Moulins plant.

It is for a customer rather than for its own needs, that Sagem studied a plant for machining precision parts. Telemecanique submitted, with the participation of its subsidiary Num and in cooperation with Leroy-Somer, a proposal for an assembly workshop for small electromechanical products in one of its plants. The Thomson project concerns the production of washing machine tubs.

The value of each of the flexible workshops already approved or being studied by Codis ranges around Fr30 to Fr40 million. The financial participation of the government will probably cover about one-third of the difference between the cost of these flexible workshops and that of conventional equipments.

The Codis procedure is intended to "create vocations" and will therefore not be permanent. It will however remain in operation for several months because of the novel character of these flexible workshops. This means that projects may still be submitted. This is what Matra, who is currently reviewing its own competence in this area and who could, for instance, submit a flexible workshop project for the machine-tool department of Manurhin, will probably do.

Hure is also interested along with its subsidiary CEF, both as a user and as a plant engineering concern. Line is also working in this area as an equipment supplier.

These pilot installations of flexible workshops which will start production in 1983 are only a first step in the government's action to promote automatization of production. The second step will be signing development contracts between the State and the companies who produce the necessary equipment (machining centers, robots, assembling machines, etc.) and the components (engines, transmissions, etc.). The third step will be the stimulation of demand, including in the PME's [Small and Medium-Size Businesses].

Rapid progress is absolutely necessary (Codis management even hopes that the first development contracts will be signed in 1981), so that French businessmen may take an honorable position among competitors. This implies that they may control the domestic market together with holding a good export position.

The demand is rapidly expanding. In France, the robot market amounted to about Fr100 million in 1980 and will increase at the rate of 30 percent a year in volume. The market for automatons in general (including machining centers, programable automatons, transfer systems, etc.) is estimated at Fr2 billion, with an increase rate of 7 percent per year in volume. Unfortunately, even considering population differences, France is already lagging behind Japan, the United States, Sweden, and West Germany in the number of installed robots. More seriously, French manufacturers only command one-third of the domestic robot market, two-thirds being filled by importers.

It is reassuring, however, to note that the first candidates for installation of flexible workshops by the Codis procedure are large industrial groups with important human and financial resources. But will they "go all out" in order to avoid the same disappointment that French industry experienced in the area of machine-tools? Whether reassuring or worrisome, the answer will soon be known.

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CODIS: VEHICLE FOR EXPRESSION OF FRANCE'S INDUSTRIAL POLICY

Paris L'USINE NOUVELLE in French 5 Feb 81 pp 58-61

[Article by Alain Pauche: "The Secret Arms of Codis"]

[Text] The purpose of Codis [Orientation Committee for the Development of Strategic Industries] is to encourage, help to discover, start a discussion, alert, guide and...help a very small number of enterprises to invest on a priority basis in areas considered of strategic interest. It is this mission that L'USINE NOUVELLE brings to light through these seven initial purposes.

Whereas 15 months after its establishment the Orientation Committee for the Development of Strategic Industries (Codis) has just produced its first results--about a dozen enterprises have had their projects adopted by the management committee chaired by Jean-Pierre Souviron--its existence has been softly criticized and even less frequently questioned, above all by those who misjudge its targets, the stakes and the obstacles.

Unquestionably, the secrecy which surrounds the deliberations of this latest industrial policy instrument, a secrecy quite well protected by high officials who are members of ad hoc commissions, has triggered an abundant amount of extremely malevolent ("the secret may be hiding nothingness," nastily stated the head of a professional group) or most erroneous comments ("the PMI [Small and Medium-Sized Enterprises] enjoyed priority access to Codis," stated the head of the professional union).

Actually, Codis, whose origin is clearly described by the retinue of the president of the republic as having been at the Elysee Palace and as being the creation of the head of state (who wanted to establish an administrative interministerial "Japanese-style" tool which could "organize a strategic dialogue" with enterprises in promising industrial sectors), is neither the mythical organism for the administration set on running things nor is it a money-making machine for deserving PMI. The reality is both simpler and more complex. In any case, it is more shaded.

It is simpler, for the reason that Codis could be classified as one of the agencies which help industry to redeploy and allow the government to express its industrial policy: the Special Industrial Adaptation Fund (FSAI) promotes the creation of new jobs in the areas most strongly affected by the restructuring of the metallurgical industry and the shipyards; and the Interministerial Committee for the Development

of Investments and Job Support (Cidise), whose purpose is to promote the growth of the PMI which have proven their viability but are handicapped by lack of adequate funds. As to Codis, its purpose is to select fields of activity which will be of determining importance for the future, to coordinate activities in the public sector which could strengthen the international competitiveness of the concerned enterprises, and even to speed up procedures through the elimination of bureaucratic obstacles.

Codis is as subjected to planning as Cidise is neo-liberal and consistent with the "Monory philosophy" of the elimination of bottlenecks. "Whereas the idea is seductive," an official of the Ministry of Finance noted, "its means are debatable: who could classify a project as worthy?" In other words, is the administration equipped to make "proper choices" among projects affecting specific industrial areas? The debate is far from being closed but it would be difficult to deny that the increased number of areas of intervention increases the possibilities of making errors of judgment.

Towards a More Fruitful Dialogue with the Major Groups

The answer which a Ministry of Industry official gives to this criticism is that "the state does not assume major risks since the concerned sectors are either in a state of intensive growth or on the eve of a tremendous future and that, in any case, this is the only way for the creation of long-term employment."

The reality is simpler also because it is possible today, after an investigation by L'USINE NOUVELLE journalists, conducted over a period of several weeks, to specify that out of the dozen or so enterprises whose projects were accepted by Codis, three-quarters were either big enterprises or branches of big groups. Today such is the case of Alcatel Electronique (CGE), Jaeger (Matra), Compagnie generale d'automatismes (CGE), Speichim, Societe automatique industrielle (Societe generale-Peugeot), Travocean (Spie-Batignolles), and Videocolor (Thomson-RCA); tomorrow this may be the case of CII-HB, SGPM or the Pasteur Institute.

The "strategic dialogue," therefore, for the time being at least, is more fruitful with the big groups which have both the personnel needed to negotiate with the administration, ideas to suggest, and guarantees to provide, than the smaller enterprises which other than ideas, have less frequently the necessary personnel and the guarantees when it becomes a question of medium- and long-term industrial projects for which the state signs a development contract.

What complicates the determination of where reality lies is the fact that some big groups mistrust, as we shall note subsequently, "Codis philosophy." After all, it is surprising that chemical and pharmaceutical groups are not included in the first negotiations with bio-industry. Unquestionably, this is merely a postponement. However, such a wait-and-see attitude says a great deal about the nature of the obstacles and relations existing between the enterprises and the state.

In some cases there are too many big enterprises and in others not enough! At this stage it would be quite hazardous to draw any conclusion, as the authorities themselves are divided in their wish to help a larger number of enterprises or focus their activities on the smaller number....

The more numerous the targets are, the more the stakes, obstacles and contradictions become apparent (Henri Tezenas from Montcel, Andre Giraud's former fellow worker, used the concept of "multiple charge weapons" in defining the new industrial policy).

When Codis was established, some 15 months ago, promoted, as we have seen, by the Elysee Palace, which wished that the Ministry of Industry become interested in "sectorial action," the selected areas--large-scale electronics, office equipment, offshore equipment, flexible robotics workshops and the bio-industry, areas which were subsequently expanded through the addition of energy conservation equipment and innovations in the textile industry (clothing) may have encouraged the belief that promotion activities favored spearhead industries. This was an error.

On the one hand, Andre Giraud, minister of industry, missed no occasion to specify that it was not a question of reviving the old-type sectorial policy whose results had been mixed (such as the machines tools plan or the policy of aid to metallurgy before the Sacilor and Usinor groups were rescued by the state), but to assist the enterprises in directing their efforts toward activities with a future. On the other hand, it now seems obvious to both the initiated and the watchful observers that the problem facing the government was both new and delicate: how to help the enterprises and promote an industrial policy in sectors independent of public markets?

Accustomed to discussions with enterprises in the armaments, telecommunications, or electronic components sectors...the state had to develop an entirely new attitude. Actually, it was at that point that the "Japanese missions" increased in number. The idea of the "strategic dialogue" was a Miti (Japanese Ministry of International Trade and Industry) patent. Indeed, it is this ministry that selects areas considered "strategic" and the corresponding enterprises, provides support and looks at results two or three years later. The process is long (five years) but effective: the Japanese are champions in the strategy of crenels and, as its accessory, of the state-enterprise dialogue.

Finally, to complete the picture, it also became apperent last year that the educational activities of this new instrument of industrial policy was frequently considered at the Elysee and Matignon palaces (the prime minister is Codis' chairman) more important than its activities themselves. This could be merely a twist, for it is easier to be judged on the basis of the value of one's pedagogy than of the results. In fact, it is a tremendous gamble. It is not the only one, as we have been able to identify four of them.

The first is political. It is a question of a conciliation between the virtues of state planning, vigorously denounced ever since Raymond Barre succeeded Jacques Chirac at the Matignon Palace, with the liberalism impetuously defended by Rene Monory on the Rue de Grenelle at the Ministry of Industry, before imposing it and applying it at the Ministry of the Economy, Rue de Rivoli. "One must realize," L'USINE NOUVELLE was told by a high official, "that in order to promote new activities such as the bio-industry and office equipment, and for protecting the trumps which the country holds in the fields of electronics and textiles, the government is forced to look for new means of intervention." The more so, adds Jean-Marie Chevalier, professor of industrial economics and prime mover of the industrial economic research center at Paris-Nord University, since "the pertinent strategy for the government is to act on a long-term basis whereas for a company it is to develop a global strategy for the marketing of individual products."

However, the restrictions which the state must take into consideration are more administrative than industrial. Few medium-sized enterprises seem to be truly

tempted by Codis, their managers being accustomed to dealing with regional administrative systems which tends to prove that the latter are not all that poor! In turn, the officials like to deal with bigger projects which, in their view, enhance their own status....Some 12 years ago, in his "Industrial Imperative," Lionel Stoleru was speaking of the administration's wish to shine.

Codis, which has been entrusted with the study of projects submitted by any enterprise, regardless of size, cannot bypass Thomson, the CGE or other major groups which are less familiar with aid subsidy procedures.

The second debt is equally political. However, in this case it is a question of a political-administrative "kitchen," the explanation of which is more delicate compared with that of principles of political economy. This is a stylish "kitchen," for it is no more and no less a question of determining whether the Ministry of the Economy should share with the Ministry of Industry the power to grant public aid. This question annoys the officials of the latter ministry and makes uncomfortable those of the former, who are split between the need to protect their own area and that of the governmental vulgate according to which everything is as it should be. Competition between the Ministries of Finance and Industry is a familiar and relatively old one. It would not make much sense to refer to it without describing the operations of Codis.

The Treasury Decides What Aid To Grant

Structurally, Codis is headed by Jean-Pierre Souviron, director general for industry at the Ministry of Industry, chairman of the management committee, and by Jean Foglizzo, a high official at the Finance Ministry, who is secretary general and head of mission attached to the director of the treasury. The principle which, justifiably, no one criticizes is to insure the joint work of the two administrations: industry, in charge of managing industrial policy, i.e., the one with the ideas and a little bit of money (industrial policy loans, Anvar...), and economics, whose task is to head economic policy, of which industrial policy is a component and which has at its disposal most of the public funds for aid to industry.

Whereas the chairman of the management committee decides on the validity of projects submitted by specialized commissions, headed by competent directors from the Ministry of Industry (see "The Men of Codis"), it is the treasury which puts together the financial file and decides what aid is to be granted. "I negotiate with the Ministry of Finance," we were told by the director of a powerful electronic group.

Matters cannot advance too far, for even though he turned Codis over to Andre Giraud, Valery Giscard d'Estaing did not, with it, give assurances to the Ministry of Industry that its role and power would be strengthened should Codis projects be developed and should the famous "single cashier's booth" for centralized aid be generalized. The treasury knows this and does not intend to share its decision-making and control powers at a time when, helped by the crisis and urged on by Andre Giraud, the Ministry of Industry is asserting its authority.

This sign is a matter of concern for the leadership "fortress" at the treasury. Actually, the fact that Francis Lorentz, Codis' secretary general until the last few weeks, left it for the private sector, is interpreted as a "victory" for the treasury. Could it be that the Souviron-Lorentz "tandem" had been operating

to the sole advantage of industry? In recalling this occasionally pressed atmosphere, a high Rue de Rivoli official prophesied somewhat ironically that he was "waiting for a president of the republic who would dare to slash to a significant extent the prerogatives of the Ministry of Finance."

In these terms, and bearing in mind the ratio of forces, the "single booth" is not about to become generalized. It is true that the generalizing of this procedure would be quite a delicate project. The enterprises whose files go through Codis would be the sole benefactors of this procedure. For the others, th "merry-go-round of tellers' booths" would go on....

Let us note that the search for assistance, whose comic nature is quite frequently denounced, does not have only disadvantages. The more complex the labyrinths become, the harder it becomes to follow the tracks. Herve Hannoun, inspector of finance, assigned in 1979 the study of public aid to industry, had a hard time following them; the government, conversely, thought it easier to suppress a report according to which about a dozen enterprises accounted for one-half of the public dole. On the other hand, the enterprises are unwilling to publicize the amount of public aid they are legally granted. Yet, the more centralized the matter becomes the easier it is to draw a balance. "The big enterprises prefer the 'multiple booths,' which are considered more discreet and are very scared of the single booth represented by Codis, which could total the amount of subsidies they are given," an observer pointed out.

Along with this secrecy and the secret strategy of the companies, and bearing in mind the mistrust of business groups, this would explain the secrecy orders issued Codis managers concerning the names of the files which have been kept (not to mention the instructions!). No names and no figures: a grave! Too bad for Codis, for a policy of secrecy brings about suspicion, encourages rumors and promotes a poisonous atmosphere, as such operations are never innocent.

Still Very Limited Means

The third bet is even more delicate: the government would like to prove that its officials could run a supercommittee without having their own financial means. Would such a bet be equally easy to win? Caution would be advised, considering the number of precautions which have been taken. Nevertheless, this organization is attractive and its methods are pragmatic.

There are seven commissions (one per topic) consisting exclusively of officials (from ministries, a few universities and researchers) in charge, first of all, of determining the nature of markets for robotics or submarine operations. Several investigations have been assigned to Sema, Ripe, the Boston Consulting Group, and Peat Marwick.

Their results have been studied, their promising markets singled out, and their ambitions determined. The ground having been thus cleared, the commission members--ranging from 15 to 25--were able to study the submitted projects, turn to other enterprises and take over the Cidise files (Cidise's secretary general performs the same functions in Codis and most officials serve in several agencies). All in all, some 20 files have been subjected to a thorough study.

It is this type of approach that explains the slowness of the process: the initial files were submitted to the management committee as late as last July and the first major set of projects was received as late as December. Unquestionably, the structure of the agency is lightweight and flexible and even pleasing: "Here, at least, is an agency which does not use funds before distributing them," public opinion states.

Even though its structure and modus operandi offer some advantages, its means are limited. It has no specific budget, no "portfolio," no special extension. Rigorous budgetary rules prevail! In fact, Codis' current activities barely exceed 2 percent of the gross industrial product: the investments pledged by the guideline committee for the 12 selected enterprises total about 10 billion francs, 6 billion of which for managerial equipment (let us note for the sake of comparison that the TGV accounts for a 7.5 billion franc investment).

These sums appear small compared to the industrial stakes in the fields of general electronics, robotics or the bio-industry. This is equally the reason for which Codis' activities are criticized even though it is the overall industrial policy which should be closely examined. In a report drafted for the Eighth Plan, Gilbert Beaux, director general of the Generale occidentale, and Philippe Lescanne, delegate general of the Center for Concerted Action of Food Industry Enterprises, denounced the "lack of coherent industrial policy which would integrate all connections with the other policies."

No More Than Seven Discussion Topics

By abandoning sectorial plans (see diagram), the state answered the question in advance: for example, there will be no plan for the bio-industry. Deregulation of prices is one thing while aid to industry is another: "It is up to the enterprises to define their strategies, formulate specific targets, supply figures and documents and sign a 'contract' with the state in order to receive the necessary aid." This is a new kind of talk (it has been described as Japanese...). It is healthy even though it might not be universally pleasing.

The fourth bet is the following: will this incantation be sufficient to lead French industry into projects of the future, encourage it to regain lost markets, and help it to preserve the hard and profitable node of textiles and clothing which, as is known, will lose some 30,000 jobs in 1981. "We neither can nor wish to substitute ourselves for the enterprises," L'USINE NOUVELLE was told by an official close to the prime minister. "However, we must make their managers aware of the need to formulate a strategy."

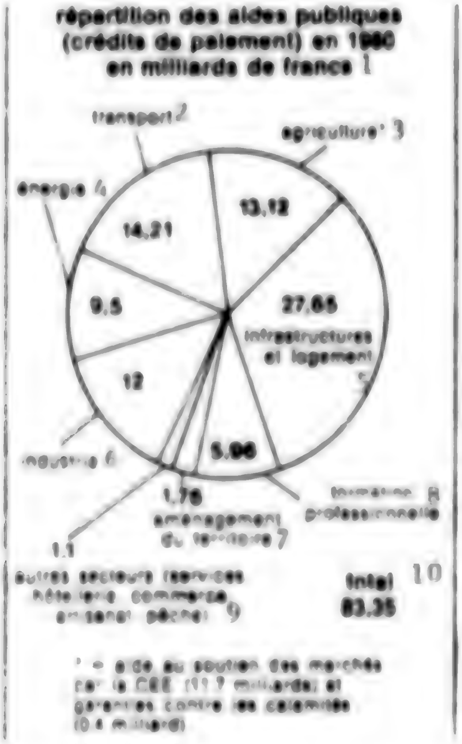
The problem, however, is that despite explanations and verifications, the industrialist do not consider Codis as an agency for consultation, as pleasingly depicted, as a committee for "strategic lookout," or a "task force of big minds" turned toward the market, but as one more agency distributing public funds!

Why then is there such a mistrustful or grumbling skepticism toward an agency which, on the contrary, must appear powerful if it is to succeed and be effective? At this point, a comparison with Japan may prove to be useful. In Japan the interventionism-liberalism debate is not formulated on the same terms as in France: the administration and the enterprises are marching, hand in hand, in their conquest of world markets. In Franch, even when enterprises act together, the image does not

reflect the same reality! Furthermore, the Japanese enterprises are accustomed to the "strategic dialogue" to such an extent that one no longer knows whether it is the state or the enterprises which formulate industrial policy.

Any model, whatever its nature, must become acclimatized. Thus, the authorities have decided not to inscribe the initially selected seven topics on their letterhead. The moment this becomes possible, a given topic will be "locked" (the accepted term) so that another one may be accepted; the principle is not to go beyond seven in order not to broaden the competences of Codis which, in the latter case, might convert from a "initiative catalyser," as defined by Christian Stoffaes, advisor to the Minister of Industry, into a duplicate Ministry of Industry. It is to be expected, therefore, that two or three topics will be closed during the first six months.

Breakdown of State Aid

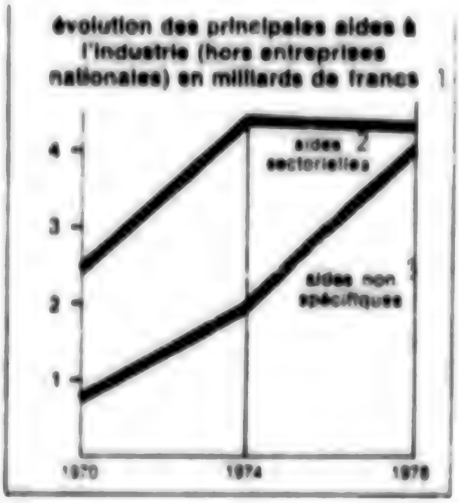


Key:

1. Allocation of public aid (payment credits) in 1980 in billion francs.
2. Transportation
3. Agriculture*
4. Energy
5. Infrastructures and housing
6. Industry
7. Territorial organization
8. Vocational training
9. Other sectors (services, hotel industry, trade, crafts, fishing
10. Total
11. *EEC market support aid (11.7 billion) and disaster insurance (0.4 billion)

In 1980 state economic aid totaled 84 billion francs (75 billion in 1978). Public aid, with the exception of the loans to the metallurgical industry, was not considered state financial aid, nor were loans for exports and job support. Let us note the following: 1. Loans granted by the FDES [Economic and Social Development Fund] and the special loans granted to industry, other than metallurgy, totaled 6 billion in 1980; 2. According to the report of the industrial redeployment group of the Eighth Plan, state aid to industry in Germany is double the amount spent by France. One-third of the funds are distributed by the Lander within the regional development framework; it is used for the long-term reconversion and development of the most capitalist-oriented and most competitive activities (source: Office of the Treasury and report of the industrial redeployment group of the Eighth Plan).

Target Aid Doubled in Four Years



Key:

1. Development of main aid to industry (other than public enterprises) in billion francs
2. Sectorial aid
3. Nonspecific aid

As late as 1978 sectorial aid accounted for over one-half of state financial aid to industry; in 1974, however, such aid accounted for over two-thirds of the total. Within a short time, the state proved its wish to redirect its activities in favor of target aid (also known as nonspecific aid) to the detriment of sectorial aid which was focused mainly on about a dozen groups. The state aid to metallurgy was quite substantial in 1976-1977 (2.3 billion francs) and to electronics and the information industry (1.2 billion allocated in 1976). Without massive aid there would have been no clean sweep of shipbuilding and our country would unquestionably not have the nuclear, aeronautic and information industries. (Source: Forecasting office of the DREE [Foreign Economic Relations Administration], report of the industry commission for the drafting of the Eighth Plan).

The Men of Codis

The management committee is in charge of preparing the Codis deliberation. So far the committee has held eight meetings. It is chaired by Jean-Pierre Souviron, director general for industry. The secretary general is backed by Jean Foglizzo, his representative to the director of the treasury.

The management committee also includes the director of the treasury, the director of foreign economic relations, the director of the budget, the plan commissioner, the delegates to Employment and the delegates to the Organization of the Territory and to Regional Action.

The procedure consists of three stages: 1. the choice of intervention areas; 2. the selection of enterprises and of the means for action; 3. the conclusion of development contracts which bind for a specific period of time the public authority and the enterprise.

The management committee is assisted by specialized work groups (one per topic) consisting of representatives of each of the concerned administrations. Each group is chaired by a competent director from the Ministry of Industry; the meetings are prepared by reporters who define the projects and are in charge of relations with enterprise managers.

Topic	Chairmen of Work Groups	Reporters
Office Equipment	Philippe Sahut d'Izarn, director of Electronic and Information Industries, 120 Rue de Cherche-Midi, Paris. Tel: 567-52-34	Mr Nicolet
General Electronics	Philippe Sahut d'Izarn	Mr Delabriere
Robotics (flexible workshops, automation)	Pierre Gadonneix, director of Machine, Metallurgical and Electrical Industries, 23 Avenue Franklin-Roosevelt, Paris. Tel: 555-93-00	Mr Pringuet
Underwater Projects	Jean-Pierre Capron, director of Hydrocarbures, 101 Rue de Grenelle, Paris. Tel: 556-36-36	Mr Naouri
Innovations in Textile-Clothing	Christian Langlois-Meurinne	Miss Demangel
Bio-industry	Christian Langlois-Meurinne, director of Chemical, Textile and various industries, 66 Rue de Bellechasse, Paris Tel: 555-93-00	Mr Silicani
Energy Conservation Equipment	Pierre Gadonneix	Mr Thomazeau

Seisin is surrendered without the opening of a preliminary file, by submission to the general secretariat (151 Rue Saint-Honore, 75056 Paris. Tel: 297-23-50) of the brief description of the project.

5157
CSO: 3102

SCIENCE POLICY

UNDIMINSHED RESEARCH EFFORT FORESEEN THROUGH 1988

Copenhagen BERLINGSKE TIDENDE in Danish 27 Dec 80 p 5

[Text] In the debate on savings in the area of higher education emphasis has been put on the unfortunate consequences this would have for research. But it seems that no cuts are planned for the next 7 years that would reduce the funding for the higher education the state will make available to the research sector.

This appears from the tables prepared by the Directorate of Higher Education for a meeting with all institutions of higher education concerning prospects for 1982 appropriations. The tables contain projections up to 1988 and include a summary of how many so-called research work years and stipends have been budgeted for 1980-88. A work year is a technical budget term for a 1-year research or fellowship post.

In 1980 a total of 1537 research work years was planned for universities, university centers, institutions of higher education, the Danish Teachers' High School, the Danish College of Journalism and the Danish Pedagogical Institute. In spite of cuts of 100 million kroner in 1981 this figure is expected to rise by 15 in that year to 1552 and to remain at that level up to 1988. A research work year that includes both permanently employed scientific personnel and part-time employees could easily cover a larger number of people.

The scholarship stipend area which has been in the spotlight due to the repeal in 1981 will also be maintained largely at the 1980 level, according to long-range plans, since 783 stipend work years in 1980 can only be reduced to 776 in 1982 and the years after that up to 1988.

But this actual increase in the share for research will not in itself solve the urgent problem of Danish research. President Carl F. Wandel, Arhus University, recently estimated that the low natural attrition of scientists means that it will cost 100 million kroner annually--for new positions--to provide for reasonable research recruitment and a good mixture of age groups in the scientific population. But the problem could also be solved by creating greater mobility among Danish research workers so they work for a limited period of time in educational institutions and then go into the business sector to a larger extent than is now the case.

6578
CSO: 3102

BRIEFS

'COMES' FUNDS UP 60 PERCENT--The 1981 budget appropriations for the COMES [Solar Energy Commission] represent a 60-percent increase. The areas undergoing greatest expansion are: promotion of use of raw energies (biomass); dissemination of the techniques of solar heating in homes and the promotion of solar architecture; research and development in the thermal field and implementation of the photovoltaic plan; and institution of concerted approaches with local communities. The Committee for Solar Energy Action deems the additional 70 million francs insufficient to provide a real solar energy start. The chairman of the COMES, which has never spared its efforts, is not far from sharing this view. Certain observers are moreover astonished that public establishments like the AEC [Atomic Energy Commission] continue to be allocated funds for solar activities that however come under the province of the COMES. [Text] [Paris SEMAINE DE L'ENERGIE in French 24 Nov 80 p 7] 9238

CSO: 3102

VEHICLE PRODUCTION FIGURES FOR 1980 REVIEWED

Paris L'ARGUS DE L'AUTOMOBILE in French 12 Feb 81 p 6

[Text] Automobile production dropped 8.8 percent -- the equivalent of 280,000 vehicles, or one month's production -- in 1980. According to the Auto Builders Association, the drop corresponds to the necessary adjustment between supply and demand and explains the measures that had to be taken in the field of employment. Lacking any solution to current tension, the drop in activity registered in recent months -- production down 17.3 percent for the last quarter of 1980 -- may well continue or even grow worse.

There is one exception, however: Diesel vehicles are gaining ground. Their production rose to 236,233 units in 1980 compared with 191,742 in 1979, an increase of 22 percent.

Automobile exports dropped 9.9 percent in 1980, totaling 1,529,652 units. For the second quarter of 1980, they were 18 percent under their 1979 level.

Production of 6 tons and under showed good overall results in 1980. Average growth for the year, 11.7 percent, shows that part of the French pool was renewed.

As for vehicles over 6 tons, production was manifestly stimulated by exports. In 1980, nearly 54,000 vehicles came off the assembly lines, 13.5 percent more than in 1979.

Production of Complete Vehicles

Type of Vehicle	Oct.'80	Nov.'80	Dec.'80	1980	1979
Under 1,000 cc	36,810	34,937	36,649	466,303	597,338
Share of production	13.4%	16.1%	16.4%	15.9%	18.5%
1,000 to 1,500 cc	157,491	115,141	122,660	1,688,977	1,817,274
Share of production	57.2%	52.9%	54.7%	57.5%	56.4%
Over 1,500 cc	81,006	67,504	64,806	783,301	807,075
Share of production	29.4%	31.0%	28.9%	26.6%	25.1%
Total Production	275,307	217,582	224,115	2,938,581	3,221,687

Source: Automobile Builders Association

Producers	Oct.'80	Nov.'80	Dec.'80	1980	1979
Automobiles					
Total · oduction	275,307	217,582	224,115	2,938,581	3,221,687
Alpine	78	123	239	1,137	1,381
Citroen	45,072	35,101	38,370	536,366	679,327
Peugeot	58,778	46,421	45,545	607,033	755,593
Renault	142,446	114,953	117,678	1,491,202	1,403,949
Talbot Matra	627	666	693	7,972	16,638
Talbot	28,306	20,318	21,590	294,871	364,799
French Production in the World (including small collections)					
Total Production	332,012	265,772	266,884	3,487,611	3,731,046
Citroen	46,812	36,202	39,710	555,084	712,942
Peugeot	61,562	46,973	48,041	631,465	786,817
Renault	185,987	154,434	149,171	1,892,378	1,744,157
Talbot	36,946	27,374	29,030	399,575	469,111
Other makes	705	789	932	9,109	18,019
Utilitarian Vehicles (Pickups, Light Vans Under 2.5 PTC)					
Total Production	30,501	26,746	28,960	307,650	275,486
Citroen	2,306	2,268	2,245	25,512	27,759
Peugeot	7,840	7,178	7,604	94,397	78,783
Renault	18,439	15,681	17,305	163,224	141,046
Talbot Matra	132	76	93	1,903	529
Talbot	1,784	1,543	1,713	22,614	27,369
French Production in the World (including small collections)					
Total Production	37,914	32,297	33,523	372,882	346,037
Citroen	7,695	5,968	5,359	70,564	81,859
Peugeot	7,840	7,178	7,604	95,261	80,967
Renault	20,463	17,532	18,754	182,540	155,313
Talbot/Talbot Matra	1,916	1,619	1,806	24,517	27,898
Light Trucks From 2.5 to Less Than 4 T PTC					
Total Production	6,172	5,678	7,308	67,802	59,633
Citroen	1,374	2,220	2,659	23,522	20,492
Peugeot	3,773	2,741	3,492	33,031	31,089
Renault	596	360	699	3,536	--
RVI [Renault Industrial Vehicles]	428	350	456	7,651	7,973
Sovam	1	7	2	62	79
Light Trucks From 4 Tons to Under 6 Tons PTC					
Total Production	260	260	235	4,016	3,653
RVI	258	256	232	3,981	3,614
Sovam	2	4	3	35	39

Medium Weight Trucks From 6 Tons to Under 9 Tons PTC

Total Production	1,353	1,152	1,177	15,633	14,932
RVI	689	701	746	8,891	7,812
Sovam	1	2	1	16	15
Unic	663	449	430	6,726	7,105

Medium Weight Trucks From 9 Tons to Under 12 Tons PTC

Total Production	844	827	837	9,853	9,415
RVI	224	200	268	2,659	2,484
Unic	620	627	569	7,194	6,931

Heavy Trucks From 12 Tons to Under 15 Tons PTC

Total Production	940	811	1,280	10,892	7,834
RVI	724	652	1,166	8,661	5,597
Unic	216	159	114	2,231	2,237

Heavy Trucks From 15 Tons to Under 20 Tons PTC

Total Production	865	772	851	8,599	7,442
RVI	795	654	753	7,297	5,701
Unic	70	118	98	1,302	1,741

Heavy Trucks Over 20 Tons PTC

Total Production (RVI)	329	328	327	3,054	2,392

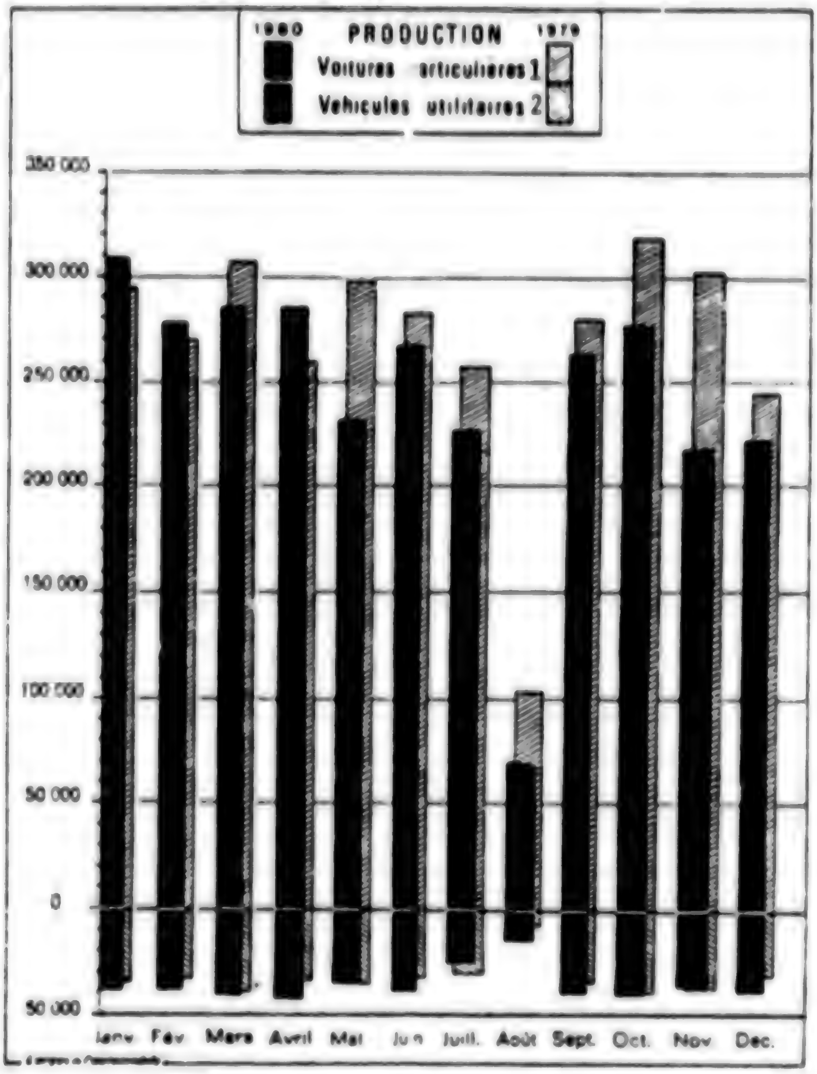
Utilitarian Vehicles, All Tonnages

Total Production	41,264	36,574	40,970	427,499	380,787
Citroen	3,680	4,488	4,904	49,034	48,251
Peugeot	11,613	9,919	11,096	127,428	109,872
Renault	19,035	16,041	18,004	166,760	141,046
Sovam	4	13	6	113	113
RVI	3,447	3,141	3,943	42,194	35,573
Talbot Matra	132	76	93	1,903	529
Talbot	1,784	1,543	1,713	22,614	27,369
Unic	1,569	1,353	1,211	17,453	18,014

French Production in the World (including small collections)

Total Production	48,677	42,125	45,533	492,731	451,338
Citroen	9,069	8,188	8,018	94,086	102,351
Peugeot	11,613	9,919	11,096	128,292	112,056
Renault	21,059	17,892	19,453	186,076	155,313
Other makes	6,936	6,126	6,966	84,277	81,618

Buses					
Total Production	266	284	306	3,084	3,333
CBM	11	10	8	105	285
RVI	255	274	298	2,979	3,048
Semi-truck Tractors					
Total Production	903	984	1,126	9,269	7,655
RVI	879	966	1,114	8,913	7,023
Unic	24	18	12	356	632



Key:

1. Passenger cars
2. Utilitarian vehicles

French Vehicle Production for Last 13 Months

PRODUCTEURS 1	Décembre 1979	Janvier 1980	Février 1980	Mars 1980	Avril 1980	Mai 1980	Juin 1980	Juillet-août 1980	Septembre 1980	Octobre 1980	Novembre 1980	Décembre 1980	Année 1980	Année 1979
Alpine	140	103	159	7	7	308	60	53	—	78	123	239	1 137	1 381
C.B.M.	8	8	9	10	11	7	10	11	10	11	10	8	105	110
Citroën	51 890	69 240	58 173	64 332	63 367	41 488	42 603	61 021	53 563	48 752	39 589	43 274	585 400	727 578
Peugeot	64 494	75 631	70 574	72 025	74 719	58 759	69 638	61 140	68 603	70 391	56 340	58 641	734 461	865 465
Renault	129 931	161 792	140 810	154 668	154 569	131 748	153 384	173 799	190 035	161 481	130 994	135 682	1 657 962	1 544 995
R.V.I.	4 910	4 783	5 219	5 198	5 204	4 104	5 430	5 512	4 321	4 581	4 381	5 355	54 085	45 819
Bovam	9	12	10	17	14	5	11	15	6	4	13	6	113	133
Talbot Matra	1 118	1 120	1 107	933	810	957	1 106	915	840	759	742	786	9 875	17 167
Talbot	22 471	34 532	30 656	29 115	29 857	27 585	32 507	32 335	25 644	30 090	21 861	23 303	317 485	392 168
Unic	1 213	1 771	1 825	1 812	1 763	1 406	1 754	1 734	1 557	1 593	1 371	1 223	17 809	18 646
Production française de véhicules complets 2	278 184	348 992	317 542	328 115	330 321	266 365	306 503	336 535	304 379	317 740	255 424	266 517	3 378 433	3 613 462
dont voitures 3	243 375	309 745	278 007	286 716	286 595	231 000	267 509	298 277	263 728	275 307	217 582	224 115	2 938 581	3 221 687
dont utilitaires 4	32 809	39 247	39 535	41 399	43 728	35 365	38 994	38 258	40 651	42 433	37 842	42 402	439 852	391 775
Jours ouvrables 5	20	22	21	21	21	18	20	28	22	23	19	22	237	234
Production journalière 6	13 810	15 880	15 210	15 620	15 730	14 800	15 330	12 020	13 830	13 820	13 440	12 110	14 250	15 410
dont voitures	12 170	14 080	13 240	13 650	13 650	12 830	13 380	10 650	11 990	11 970	11 450	10 190	12 400	13 770
dont utilitaires	1 640	1 780	1 880	1 970	2 080	1 980	1 850	1 370	1 850	1 850	1 990	1 930	1 860	1 670

PRODUCTION DE VEHICULES FRANÇAIS DANS LE MONDE (Y COMPRIS LES PETITES COLLECTIONS POUR FABRICATION A L'ETRANGER) 7

	Décembre 1979	Janvier 1980	Février 1980	Mars 1980	Avril 1980	Mai 1980	Juin 1980	Juillet-août 1980	Septembre 1980	Octobre 1980	Novembre 1980	Décembre 1980	Année 1980	Année 1979
Citroën	58 867	78 611	85 858	88 491	88 741	48 193	47 879	68 337	59 301	55 881	44 390	47 728	649 170	815 173
Peugeot	67 614	77 889	73 398	74 343	77 229	61 207	72 134	83 348	71 123	73 175	56 892	65 137	758 737	898 863
Renault	187 338	200 029	181 453	192 141	189 172	189 398	189 218	223 858	185 249	207 046	172 326	168 624	2 078 454	1 888 476
Talbot	28 113	45 144	39 732	41 147	38 497	38 393	44 755	42 279	31 852	38 730	29 917	30 743	422 189	496 482
Autres marques 8	7 398	7 787	8 329	7 975	7 809	6 787	8 371	8 248	6 534	7 026	6 649	7 817	83 125	83 256
Production totale	318 478	407 180	388 728	384 299	382 458	322 940	362 149	406 018	354 059	381 858	309 183	313 849	3 982 885	4 183 372
dont voitures	277 811	361 481	322 433	338 758	333 301	282 233	317 511	358 853	307 267	332 012	285 772	266 864	3 487 811	3 731 046
dont utilitaires	38 863	45 699	46 295	45 541	49 157	40 707	44 638	48 051	46 792	49 846	43 393	46 985	505 084	466 32[illegible]

Key:

1. Producers
2. French production of finished vehicles
3. Passenger cars
4. Utilitarian vehicles
5. Working days
6. Daily production
7. Production of French vehicles in the world (including small collections for manufacture abroad)
8. Other makes

1,707,778 Vehicles Exported in 1980

Exporters	Pass.Vehicles	Util.Veh. up to 6 T	Util.Veh. over 6 T	All Vehicles
Total Exports	1,529,652	149,303	28,823	1,707,778
Citroen	269,223	16,521	--	285,744
Peugeot	298,589	74,050	--	372,639
Renault	779,562	36,535	--	816,097
RVI	--	8,846	14,134	22,980
Talbot	182,278	13,350	--	195,628
Unic	--	--	14,689	14,689

50.5 Percent of Production Exported

Types of Vehicles	Production Vehicles Using Gas	Production Diesel Vehicles	Production All Vehicles	Export - All Vehicles
Up to 1,000 cc	466,303	--	466,303	245,417
1,000 to 1,500 cc	1,688,977	--	1,688,977	830,079
Over 1,500 cc	547,068	236,233	783,301	454,156
Total automobiles	2,702,348	236,233	2,938,581	1,529,652
Under 2.5 PTC	276,428	31,222	307,650	133,972
2.5 to 3.9 PTC	19,243	48,559	67,802	8,963
4 to 6 T PTC	122	10,406	10,528	6,368
6.1 to 8.9 PTC	6	9,115	9,121	6,178
9 T to 11.9 PTC	183	9,670	9,853	7,298
12 T to 14.9 PTC	--	10,892	10,892	5,808
15 T to 19.9 PTC	--	8,599	8,599	4,457
Over 20 T PTC	--	3,054	3,054	1,797
Total	295,982	131,517	427,499	174,841
Semi-truck Tractors	--	9,269	9,269	2,437
Buses	--	3,084	3,084	848
Total Utilitarian Vehicles	295,982	143,870	439,852	178,126
Total All Vehicles	2,998,330	380,103	3,378,433	1,707,778

11,464
CSO: 3102

TRANSPORTATION

NEW DANISH AUTOMOBILE TO BE MASS-PRODUCED

Copenhagen BERLINGSKE TIDENDE in Danish 12 Jan 81 p 7

[Article by Kirsten Sorrig]

[Text] The first Danish car in recent times will now go into mass production. Ten cars a week will be produced which will create jobs for between 400 and 500 people.

"Contracts have already been signed for the delivery of around 1000 cars and therefore I have been in touch with a number of Danish subcontractors," said Bent Due, the man behind the new Safari car.

It is Bent Due's wish to have the car produced entirely in Denmark and agreements have already been reached on delivery of glass, tires, wheels and fiberglass. But so far it is still necessary to buy some of the parts for the car abroad.

Foreign Interest

"Foreign interest has been enormous and some of the cars will be exported. Both West Germany and Sri Lanka have offered to make firms and capital available but I have turned them down," said Bent Due.

He is not interested in a foreign contract or in having a single large Danish firm produce the car.

"There is big money in foreign production but I don't want to become a millionaire because of the car. I will be satisfied if I can keep afloat and I would rather have a small firm where I can be involved at all times."

Will Cost 39,040 Kroner in Cash

The Safari car was presented at the Christmas Market in Abenra in December and there has been enormous interest in it since then. Especially since the price, including all taxes and fees, is 39,040 kroner, but this must be paid in cash on delivery.

At present 80 percent of the car is produced in Denmark and several recycled elements are used in production with among other things the engine, gear box, front and rear axle assemblies coming from old Volkswagens.

All in all the car has been greatly inspired by the VW but it weighs 300 kg less. Technically it is based on the old VW Type 1 with a box motor in the back and the gas tank in the front but in appearance it more closely resembles a cross between a beach buggy and a jeep.

"The price is not the only reason for the popularity of the Safari. It is made especially for Danish conditions. It has good gasoline economy, doesn't rust and can be used to transport the whole family. But it is important to emphasize that it is a transport car anu not a comfortable luxury car," said Bent Due.

He is currently looking into the economic possibilities of producing the car entirely in Denmark and hopes that an efficient Danish production of the Danish car will soon get under way.

6578
CSO: 3102

AERODYNAMICS STUDIED FOR FUEL-SAVING AUTO DESIGN

Paris SCIENCES & AVENIR in French Dec 80 pp 62-66

[Article by Laurent Bromhead: "Automobiles in the Wind"]

[Text] Will all tomorrow's cars be shaped like a teardrop? A Cartesian mind might thinks so, knowing on the one hand that the aim of the big makers of automobiles is that their cars consume less and less fuel, and on the other hand that the teardrop is the shape that most easily penetrates the atmosphere, the shape, in other words, that encounters the least resistance to its forward movement, provided one disregards ground effects, of course. Since our engineers today are able to master the laws of aerodynamics, why do they not simply apply them without further delay?

This is where the aerodynamist must "struggle" against the stylist, the one who designs the car from the standpoint of making as attractive as possible, basing it on the specifications of the marketing experts, who know (or rather, hope they know) the profile of the average buyer. Even until recently, the stylist has always won out: The least of their concerns was that the car should glide along through the air "like a hot pressing iron," because gasoline was not all that expensive... This postulate is no longer acceptable today, and it is not hard to imagine the match now beginning to even up. Suppose, then, that henceforth a car's aerodynamics should outweigh its styling in the final decision. What might the car of tomorrow look like? And more fundamentally, will the laws of physics lead to a new aesthetics?

Although the big makers of cars guard the secrecy of their plans jealously, it is nevertheless possible to respond in large part to these questions. To begin with, says Jean-Claude Corbel, head of the Department of Aerodynamics and Vehicle Synthesis at Citroen, "a car designed strictly on the basis of its aerodynamics alone will never be built. There will be no art for the sake of art; otherwise, all the builders would probably end up with very similar shapes." This is all the more so since the market is evolving toward the range midpoint of "the not too cumbersome family car" and since, moreover, the number of car makers is constantly diminishing.

The fact is that the average buyer invariably affirms he or she considers the car utilitarian, whereas, frequently, the car is being bought purely as a luxury item to enhance one's status. The oil crisis is compelling the government to impose a reduction in gasoline consumption. And now the more the user can pride himself on owning a car that is not a "gas guzzler" but is on the other hand luxuriously equipped, the happier he is. More often than not, he will have to accrue savings over many thousands of kilometers to recover his investment in gadgets! But that matters little.

All of this has to do more with the laws of .pply and demand than with those of fluid dynamics. When a new car is being conceived, its level of consumption and its desired performance characteristics are set to begin with; then, its targets, namely, its potential customers.

This determines the passenger space and the power of the motor. The volume of the trunk and of the fuel tank are then calculated, and even the placement of the spare tire is determined. Next comes the stylist, to render the vehicle pleasing to the eye and to the touch, followed by the salesmen, who judge whether the result is really attractive, after which market surveys are undertaken. Only then does the aerodynamist enter into action, to adjust the parameters as best as by then may be possible. Finally comes a synthesis of all these studies, which for the past 5 or 6 years has been carried out using a computer, starting from mathematical models.

Why do all men's suits have a slit in the sleeves at the level of the wrist with three buttons attached? A mystery--even for the tailor, who does not even bother to ask himself why. However, he also follows certain rules of the art the purpose of which is to ensure the quality of the suit. It is the same thing with the designer of a new car, except that for a long time he has often disregarded its aerodynamics. Now, although in city driving the energy savings owing to efficient atmospheric penetration is less than 1 percent, at 90 km/h it is around 5 percent, and at 120 km/h it is around 7.5 percent.

Hence the change in attitude and the attention being focused on the pictures being taken in wind tunnels to prove that the air will actually slide over the car's body without generating vortices. The fact is that the least turbulence results in a loss of fuel, because to set the air in rapid rotary motion it must be supplied with energy--energy that does not serve to move the vehicle forward. Furthermore, this vortex, taken as an entity, must be carried along with the car, hence moved, representing additional lost energy.

Following the grand reign of aesthetics during the 1950's and 1960's, then that of chrome and useless, even dangerous, beautifiers during the 1970's, we are now in the era of economies: fine-tuned engines and fuels, optimized oils and compression ratios, electronic ignition, new types of tires, etc... and indispensable aerodynamics. Before going into the economies possible in the latter area, let us consider, to begin with, its basic principles.

To move over the ground, any rolling object must overcome two kinds of forces: first, resistance to rolling, which varies according to the condition of the surfaces in contact (in this case, the road and the tire) and to the mass of the vehicle; this resistance is greater at lower speeds; and second, resistance to forward motion, which depends on the shape of the moving object and on its leading surface, that is, the surface seen by an eye placed exactly along the car's longitudinal axis; the higher the speed, the greater is this resistance. It is on this second force that aerodynamics will come into play when the car is studied in the wind tunnel.

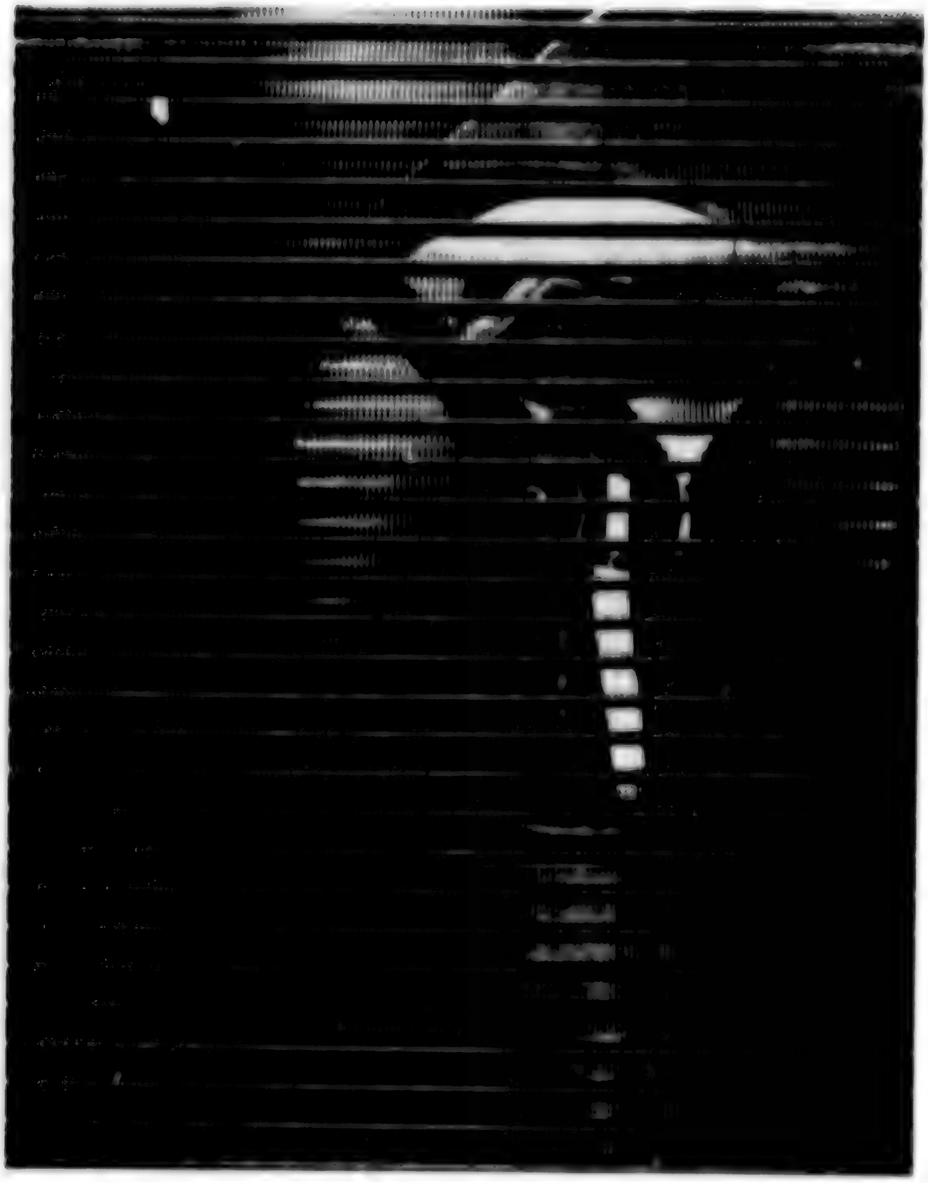
The first air resistance measurements date back to the 16th century and were made on objects in free fall. During the 19th century, a new method made its appearance: The object to be studied was subjected to an artificial air current, giving birth to the principle of aerodynamic wind tunnels. In the beginning, ventilation was produced by means of compressed air; later, by means of a pressure blower; and finally, today, by means of an exhaust blower (that is, a blower installed at the rear). In 1909, Eiffel added a collector and a diffuser to complete the classic scheme of the modern wind tunnel, like that of Saint-Cyr, used by all the French car makers.

The automobile is placed in a central room called a test chamber, into which air enters from the front, exits from the rear, and is then propelled to the front again by two blowers that force it around the left and right sides and over the top of the test chamber. In this vertical circuit, the air encounters a surge chamber (at the forward end), a room that opens into the collector, from which it rushes into the test chamber. At its exit from the test chamber, the air is again diffused.

Although the test chamber measures around three times the length of the vehicle, its cross-section is of the order of 15-20 m^2, or 10-20 times the cross-section of the vehicle. The wind speed reaches 160 km/h with a stability of around 1 percent in time and space. This homogeneity is very important, as is also the thinness of the "ground boundary layer," a zone in which the presence of the ground results in the fluid, that is, the air, being "virtually dead."

In addition to wind tunnels like this for testing vehicles in their actual size, there are the scaled-down wind tunnels for testing scale models, based generally on a 1:5 reduction. These preliminary tests on shapes are more rapid and less costly. They pave the way for the full-scale tests.

With the prototype placed in the test chamber's air current, the effects it undergoes are measured. This is done by means of two techniques: The stream lines will be made visible; but first, all the forces acting on the vehicle from all directions will be measured by means of a balance. The automobile is placed on a mobile tray on which its least movements in any of the three directions--longitudinally along the Z-axis, transversely along the Y-axis, and vertically along the Z-axis--can be measured.



To assess the aerodynamics of cars, they are placed in a wind tunnel. Blowers like these are used to simulate the wind that resists the car's forward motion.

In wind, an automobile, like any other object that is being displaced, is subjected to forces: The drag along the X-axis tends to slow the vehicle; the shift along the Y-axis tends to swing it to the right or the left of the road; and the lift along the Z-axis tends to raise it off the ground. To completely define what the car undergoes, we must add to these three forces three "moments," translating to some extent the overall rotary movement about these axes. Thus, roll (rotation about the X-axis) indicates that the car leans to the left or the right; pitching (Y-axis), that it leans forward or to the rear; and yaw, that it turns leftwards or rightwards.

Most of these components affect mainly its stability, and particularly its sensitivity to lateral wind gusting. And although all these forces are interactive among themselves, the only one that really counts from the standpoint of trying to economize on energy is the drag, also referred to as the resistance to forward motion. It goes without saying that the game will consist entirely of trying to minimize it.

The formula that defines this drag force is very simple. One need only multiply: 1/2 by the density of the air, by the frontal surface S of the vehicle (the surface projected on a plane--the surface we referred to above as that seen by an eye located exactly along the axis), by the square of the wind speed in the wind tunnel (equivalent to the simulated speed of the vehicle), by a certain coefficient known as Cx, which depends upon the car. It is clear in this formula that 1/2 will always be 1/2 and that on level ground the air density will be virtually constant. It follows from this that the faster the speed the greater will be the drag. Thus, if one goes from 50 km/h to 100 km/h the drag is multiplied by 4. Lastly, the drag depends also upon Cx S, the drag coefficient multiplied by the frontal projection.

We must point out in this regard that a common error is that of considering only the Cx in judging the aerodynamics of a car. Actually, a car with a very good (meaning a low) Cx but a large frontal surface could prove less aerodynamic than one with these characteristics inverted. In fact, in the Citroen line, the Cx of the LNA is not as good as that of the CX (0.36 versus 0.39) but the frontal surface of the former is smaller (1.70 m^2 versus 1.92 m^2). Thus, the product (Cx)S is 0.66 for the LNA and 0.70 for the CX.

Similarly, the calculations are arrived at, in the wind tunnel, for the sway, lift, roll, pitch and yaw coefficients. Curves are then developed for their variation as a function of the angle between the axis of the vehicle and the axis of the wind (in this case, the axis of the wind tunnel).

The effect of a lateral wind can be simulated: A car running at 130 km/h in a 40-km/h perpendicular lateral wind can be simulated by a 136-km/h wind at an angle of 17° with the axis of the vehicle. The balance measures the weights applied to the front and rear axles under all possible wind configurations, providing a check of the vehicle's road stability. For example, a 1,200-kg car (800 front, 400 rear) is "lightened" by 98 kg in front at a speed of 150 km/h in a lateral wind of 80 km/h.

Scale model of Renault's experimental vehicle Eve being tested in wind tunnel.

All these measurements provide us with objective aerodynamic criteria. But how are we going to understand the why of the results obtained and how to modify the car to improve them? For this, we must visualize the aerodynamic flow of the air around the body of the car, in other words, make the stream lines visible. Two very simple methods are used: In one, strands of wool are glued regularly over the the entire surface of the car, which will vibrate in case of local turbulence; in the other, a jet of white smoke is released some meters in front of the vehicle, which curls around the body of the vehicle in accordance with the stream lines.

The purpose of this study is twofold: Firstly, it will show up any possible flaws in the design by making visible the famous vortices we have referred to above, which consume energy uselessly; and secondly, it will reveal anything that might adversely affect the operation of certain components, such as the brakes. It is indispensable, for instance, that these be properly cooled, hence ventilated. During the wind tunnel tests, it is possible to deduce the shape of the deflector plates needed to direct the air on them to cool them.

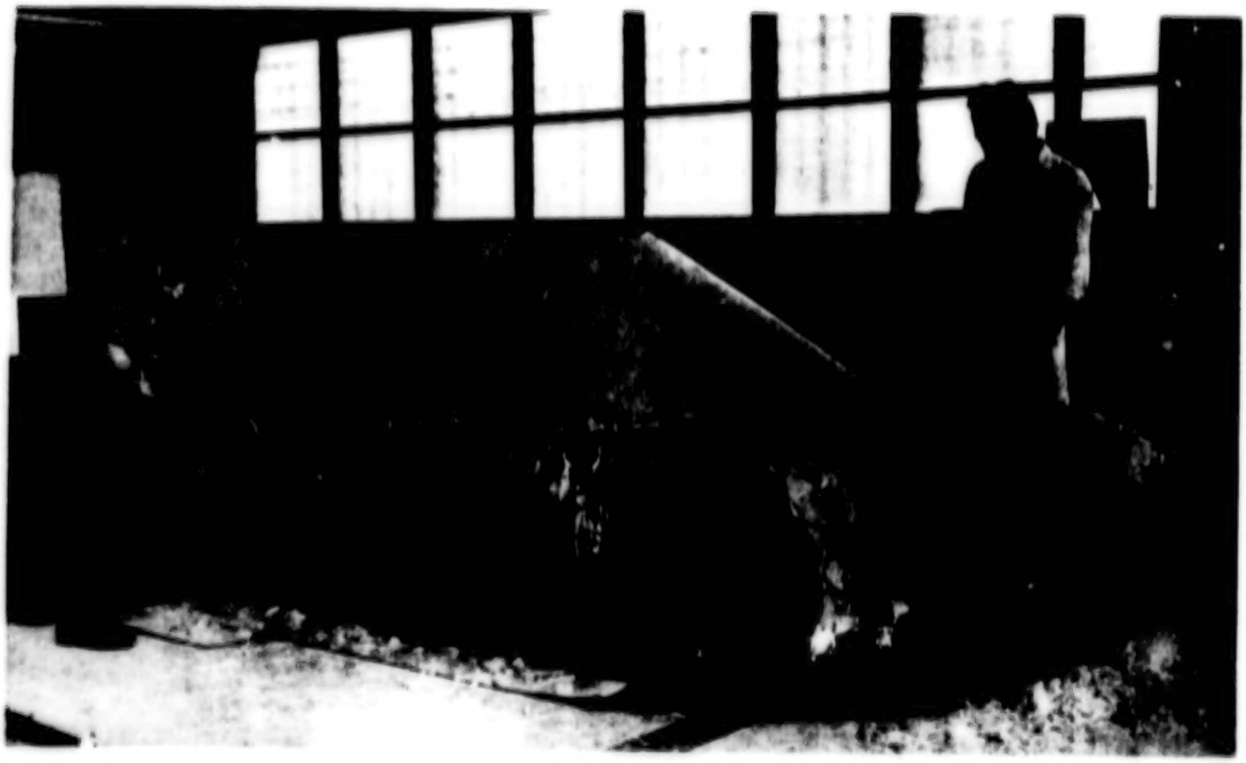
The same kind of experimentation enables the optimization of the cooling of the engine and the ventilation of the passenger compartment. The basis of this method is a simple law discovered by the French mathematician Bernouilli: Where the air pressure is high, its velocity is low; conversely, where the stream lines cling to the body of the vehicle and the air circulates against it at high velocity, a low pressure is created. Let us look now at the profile of a car with the wind coming from the front: Some of the air will flow underneath the vehicle, while the rest flows over the top. At the point of separation of these two airflows we find an intermediate zone near the front bumper where the air swirls vortically. It does not cling to the body, and it does not circulate rapidly; hence, it is a high-pressure zone. It is from there, therefore, that the air will most easily enter under the hood to cool the engine. All that need be done is to provide an opening.

On the other hand, underneath the vehicle, over its hood in front and over its roof, the stream lines cling to the metal; the air pressure is therefore low. At the junction of the hood and the front windshield, however, the stream lines leave the body; another zone, therefore, where openings can be placed for ventilation of the interior.

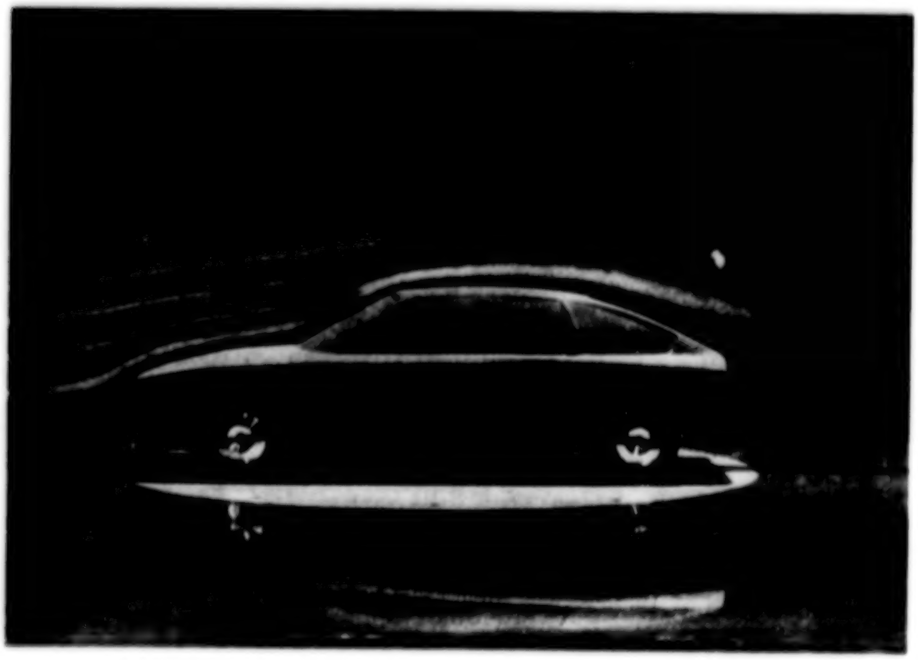
By means of different probes, the engineers measure the pressures and trace over the car's body the lines of equal pressure, as is done on a weather map. These provide a check of the proper operation and stability of the car.

But we have seen that aerodynamics must be called upon to play an increasingly important role in the design of automobiles, primarily because of the potential involved for economizing energy. Let us take a look now at what the scientists do in this regard based on all the figures obtained in the wind tunnel.

The power the engine must furnish to move the vehicle forward is calculated by adding all the powers needed to overcome the two forces: on the one hand, the aerodynamic resistance (which we have just discussed and which depends upon the coefficient (Cx)S), and on the other hand the friction within the vehicle itself



Above: A car must be provided with an engine and... be able to carry passengers. These imperatives determine the work of the stylist as he constructs scale models in plaster, like the one we see here, in the Citroen shops. One of these preliminary shapes will serve as a reference and its measurements will be furnished to the computer, then processed, to arrive at the final model, which will also take into account the results of wind tunnel tests.



Left: This 1:5 scale model of a Citroen is undergoing an aerodynamic check at the Saint-Cyr wind tunnel. Using the smoke method, the stream lines that "flow" around the vehicle are made visible.

and the coefficient of friction of the tires against the road. Now, as long as the power lost owing to friction increases linearly with speed (multiplied by 2 between 50 and 100 km/h), the power that must be supplied to overcome the air resistance increases with the cube of the speed (multiplied by 8 between 50 and 100 km/h).

This is why th car's aerodynamics becomes especially important at speeds over 90 km/h. Improving the (Cx)S by 10 percent reduces the theoretical consumption by 7.5 percent at 120 km/h, and by 5 percent at 90 km/h (versus only 1 percent in the city). The Cx of current vehicles varies from 0.3 to 0.5, and their (Cx)S from 0.5 m^2 to 0.9 m^2 approximately. There are therefore wide differences. Forward strides have nevertheless been substantial. To run at 120 km/h, a 4-door sedan in 1921 needed 75 hp with a (Cx)S of 1.437 m^2; the same performance was obtained in 1934 by a "Traction" with 56 hp and a (Cx)S of 1.230; then by a DS in 1956 with 43 hp and 0.817 (Cx)S; and lastly, by the GSA X 3 in 1980 with 31 hp and a (Cx)S of 0.575.

The most recent improvements have been achieved through the addition of spoilers in front that serve the purpose of air deflectors to reduce the airflow beneath the body of the vehicle, and of fairing at the rear, which reduces the drag by acting on the rear lift; without forgetting the increasingly aerodynamic rear windshields. With a reduction of 2.7 percent through the spoiler, and of 7.5 percent through the fairing, we have improved the Cx coefficient by 10 percent.

It is reasonable to suppose that henceforth all the car makers will use similar techniques and that thus tomorrow's automobiles will probably have fairly similar aerodynamic coefficients. As for the present, it is likely that the many fairings and spoilers, the sales of which are currently being promoted in an effort to save energy, will shortly lose their importance. These additions to new vehicles are not justified except on vehicles of a prior generation. The seek to rectify certain errors of the past. Again it must be pointed out that the amortization of their purchase price will represent quite a performance on the part of the driver. Clearly, the vehicle of tomorrow will have to be aerodynamic from the start.

The government has now induced the two principal French car makers, Renault and Peugeot, to study the profile of this car of tomorrow, with appropriations of funds in the amounts of 800 million and 700 million francs respectively. The most recent Automobile Exposition has unveiled the results of this work: "Eve" by Renault and "Vera" by Peugeot, two experimental vehicles that are expected to satisfy the public from the standpoint of performance and passenger room. The same customer, the same physical laws... Eve and Vera might well have resembled each other as do two teardrops... This, however, is not the case; far from it. The fact is that Eve recalls the line of the R 18, and that Vera is a drastically modified 305.

The Cx's of 0.32 for the Vera and 0.25 for Eve's scale model represent a net improvement over the approximate 0.4 Cx of their godparents. But to the aerodynamics there has been added a lightening of many components, owing, among other

things, to the use of plastics and to engine improvements, to achieve an overall 25-percent reduction in consumption. In any case, these are but experimental vehicles that will certainly never be mass produced because they are too "harsh" or ill-fitted to the rules of styling the importance of which we discussed at the beginning of this article.

Whereas Renault and Peugeot have for a long time centered their efforts on the engine and have, therefore, much to catch up on in aerodynamics, Citroen, until now less advanced in engine design, has heretofore concentrated on shape and is now trying to close the engine gap. These two approaches will undoubtedly converge 10 years from now to produce vehicles with a Cx around 0.2, a sort of theoretical end-wall.

The objective is not to achieve an ideal shape, but rather an ideal car. And the car is nothing other than a high-consumption industrial item. Economy, therefore, takes precedence over science. But this time, the oil crisis is leaving no choice and the science of aerodynamics seems to have taken advantage of the situation to impose its laws. That challenge is now on the way to being won. The driver, however, has hardly had time yet to appreciate its effects, and, already, the government has issued a new challenge: an experimental vehicle that does not consume more than 3 liters per 100 km. And already, in the corridors of the laboratories, it is being murmured that by the next Automobile Exposition it will be a reality. In 1982...

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